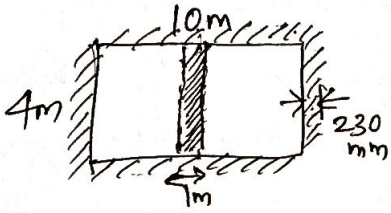
Q: Design a simply supported RCC slab for an office having clear dimensions 4m x 10m with 230mm masonry walls all around. The slab carries 4 kN/m² liveload & 1 kN/m² floorfinish. Use M25 concrete and Fe415 steel.



Ans:

1. Determine the type of slab

$$\frac{L}{B} = \frac{10}{4} = 2.5$$

$$> 2 \Rightarrow \text{One-way slab}$$

2. Determing depth

effective span (l) = c/c dist b/w supports

= 4000 + 230

= 4230 mm

for simply supported slabs

$$\frac{l}{d} \leq 20 \times 1.25$$ ← Modification factor

$$\frac{4230}{d} \leq 25$$

$$\Rightarrow d \geq \frac{4230}{25} = 169.20 \text{ mm}$$

Take d = 175 mm

Assume effective cover = 25 mm

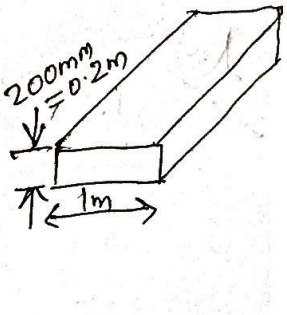
∴ Overall depth D = 175 + 25

= 200 mm

Finding effective span:

effective span (l) = min of { c/c dist b/w supports = 4230mm ; clearspan + d = 4000 + 175 = 4175 mm }

= 4175 mm or 4.175 m



Determine moment to be resisted:

$W_{LL} = 4\ kN/m^2 \times 1m = 4\ kN/m$

$W_{FL} = 1\ kN/m^2 \times 1m = 1\ kN/m$

$W_{DL} = 25\ kN/m^3 \times 1m \times 0.2m = 5\ kN/m$

total load W = 10 kN/m

factored load $W_u = 1.5W = 1.5 \times 10$

$= 15\ kN/m$

factored moment $M_u = \frac{W_u l^2}{8} = \frac{15 \times 4.175^2}{8}$

$= 32.68\ kNm$

Finding M_{ulim}:

$M_{ulim} = 0.36\ f_{ck}\ b\ x_{umax}\ (d - 0.42\ x_{umax})$

$= 0.36 \times 25 \times 1000 \times 0.48 \times 175\ (175 - 0.42 \times 0.48 \times 175)$

$= 105.63 \times 10^6\ Nmm = 105.63\ kNm$

$\Rightarrow M_u < M_{ulim} \Rightarrow$ Safe

finding depth of neutral axis:

$$M_u = 0.36 f_{ck} b x_u (d - 0.42 x_u)$$

$$32.68 \times 10^6 = 0.36 \times 25 \times 1000 \, x_u (175 - 0.42 x_u)$$

$$\Rightarrow 3780 x_u^2 - 1575000 x_u + 32.68 \times 10^6 = 0$$

$$x_u = 21.90 \text{ mm}$$

$x_{umax} = 0.48 d$ (Fe415 steel)

$= 0.48 \times 175 = 84$ mm

Since $x_u < x_{umax} \Rightarrow$ Underreinforced section

$\therefore$ OK

finding Ast:

$$x_u = \frac{0.87 f_y A_{st}}{0.36 f_{ck} b}$$

$$\Rightarrow A_{st} = \frac{21.90 \times 0.36 \times 25 \times 1000}{0.87 \times 415}$$

$$= 546 \text{ mm}^2$$

Assuming 12mm ϕ bars,

spacing $s = 1000 \frac{A_b}{A_{st}} = 1000 \times \frac{\pi/4 \times 12^2}{546}$

$= 207$ mm

Check for spacing of Main bars

↳ spacing < 3d or 300 mm whichever is less

< (3×175) or 300mm
= 525mm

< 300mm

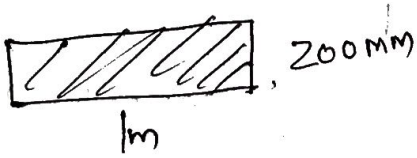
But we found s = 207 mm

Provide 12mm ϕ Main bars @ 200mm c/c

Providing distribution bars:

As (dist) = Ast,min = 0.12% gross area

$= \frac{0.12}{100} \times 1000 \times 200$



$= 240\ mm^2$

Provide 8mm ϕ bars,

$s = 1000 \frac{A_b}{A_{st(dis)}} = 1000 \times \frac{\pi/4 \times 8^2}{240}$

$= 209\ mm$

Spacing check for distribution bars:

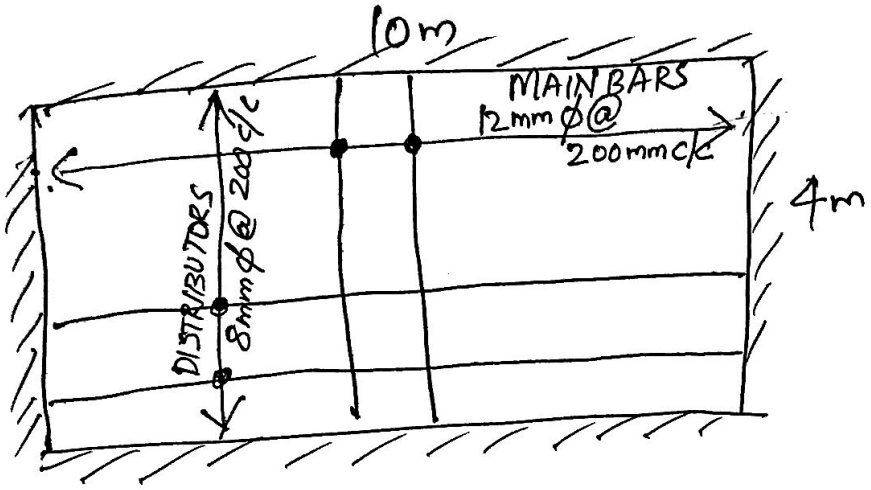
spacing < 5d or 450 mm, whichever is less

< 5×175 or 450mm

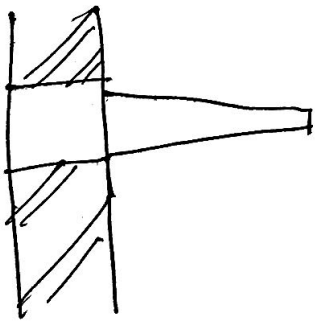
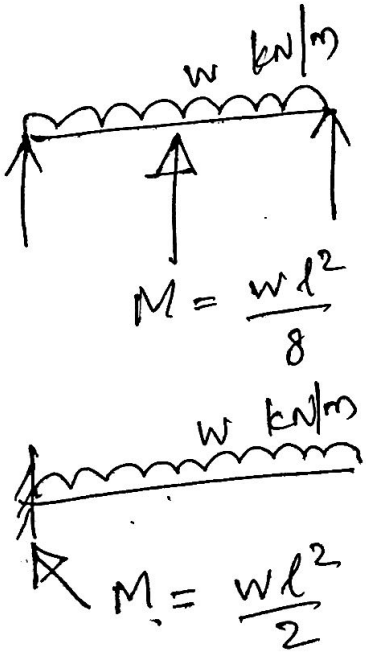
= 875 mm

< 450 mm

Provide 8mm ϕ Distribution bars @ 200 mm c/c



Simply supported slab : $\frac{l}{d} \leq 20 \times 1.25$

Cantilever slab : $\frac{l}{d} \leq 7 \times 1.25$

(sun shade)